

Creek and Keeler, Cal.; Montrose, Colo.; Parkston, Dak.; Cairo, Palestine, and Springfield, Ill.; Butlerville, Sunman, and Vevay, Ind.; Fort Reno, Ind. T.; El Dorado, Globe, Independence, Ninnescah, and Yates Centre, Kans.; Frankfort, Lexington, and Louisville, Ky.; Grand Coteau, La.; Leon de Aldamas, Mex.; Lamar and Springfield, Mo.; Milan and Nashville, Tenn.; Cleburne, Tex. 23d, Mobile, Montgomery, and New Market, Ala.; Fort McDowell and Whipple Barracks, Ariz.; Lead Hill and Little Rock, Ark.; Fort Bidwell, Louis Creek, and Sacramento, Cal.; Montrose, Colo.; Pensacola, Fla.; Savannah, Ga.; Fort Gibson, Fort Reno, and Fort Sill, Ind. T.; Dodge City, Kans.; Lexington, Ky.; Grand Coteau, New Orleans, and Shreveport, La.; Biloxi, Miss.; Fort Stanton, Las Vegas, Lava, and Santa Fé, N. Mex.; Ashwood, Chattanooga, and Nashville, Tenn.; Cleburne, Corsicana, Gallinas, Galveston, New Ulm, and San Antonio, Tex.; Fort Laramie, Wyo. 24th, Fort Buford, Dak.; Dodge City, Kans.; Leon de Aldamas, Mex.; Fort Assinaboine, Fort Custer, Fort Maginnis, Mont.; Fort Stanton, N. Mex.; Abilene, Cleburne, Comanche, Galveston, and Silver Falls, Tex.; Brock's Ranch, Utah. 25th, Las Animas, Colo.; Fort Buford, Fort Sully, Huron, Rapid City, and Webster, Dak.; Fort Supply, Ind. T.; Ninnescah, Kans.; Leon de Aldamas, Mex.; Rose, N. Y.; Cedar Hills, Cleburne, and Comanche, Tex.; Brock's Ranch and Fort Du Chesne, Utah. 26th, Hot Springs, Ark.; Las Animas, Colo.; Webster, Dak.; Fort Reno and Fort Supply, Ind. T.; Albion, Amana, Ames, Auburn, Bancroft, Cedar Rapids, Clear Lake, Cresco, Des Moines, Dysart, Elkader, Glenwood, Hampden, Independence, Manson, Maquoketa, Monticello, Osage, Sac City, and Vinton, Iowa; Allison, Tribune, and Wakefield, Kans.; Shreveport, La.; Leon de Aldamas, Mex.; Duluth and

Fort Snelling, Minn.; De Soto, Genoa, Marquette, North Platte, Omaha, and Syracuse, Nebr.; Fort Stanton and Gallinas Spring, N. Mex.; Brownsville, Cedar Hills, Comanche, Corpus Christi, Corsicana, Fort Elliott, Galveston, Mesquite, Palestine, San Antonio, and Silver Falls, Tex.; Deuster, La Crosse, Madison, Prairie du Chien, and Waucousta, Wis.; Fort McKinney, Wyo. 27th, Fort Smith, Ark.; Las Animas, Colo.; Fort Reno, Fort Sill, and Fort Supply, Ind. T.; Ames, Auburn, Cresco, Independence, and Mauston, Iowa; Dodge City, Independence, Ninnescah, Tribune, and Wakefield, Kans.; Marquette, Mich.; Culbertson, De Soto, North Platte, and Omaha, Nebr.; Abilene, Cedar Hills, Cleburne, Comanche, Decatur, Fort Elliott, and Mesquite, Tex.; Deuster and La Crosse, Wis. 28th, Athens, Ga.; Fort Supply, Ind. T.; Cresco, Iowa; Globe, Salinas, and Wakefield, Kans.; Cedar Hill, Cleburne, Comanche, Corsicana, Gallinas, Galveston, Mesquite, New Ulm, Palestine, and San Antonio, Tex. 29th, Cairo, Ill.; Shreveport, La.; Portland, Me.; Dudley and Provincetown, Mass.; Fort Maginnis and Helena, Mont.; Antrim, N. H.; Moorestown, N. J.; Ardenia, Brooklyn, Fort Columbus, and Setauket, N. Y.; Brownsville, Corpus Christi, and Corsicana, Tex.; Middlebury, Vt.; Spokane Falls, Wash. 30th, Livingston, Ala.; Rapid City, Dak.; Sebastian, Fla.; Cornish, Gardiner, Kent's Hill, and Portland, Me.; Provincetown, Mass.; Poplar River, Mont.; Hay Springs, Nebr.; Concord, N. H.; Clayton and Moorestown, N. J.; Albany, Columbus, Cooperstown, Factoryville, Humphrey, Oswego, Palermo, Plattsburg Barracks, Palmyra, and Rose, N. Y.; Bellevue, College Hill, Jacksonborough, Ruggles, and West Milton, Ohio; Drifton, Pa.; Chattanooga, Tenn.; Middlebury, Saint Johnsbury, and Stratford, Vt.; Cheyenne, Wyo.

### MISCELLANEOUS PHENOMENA.

#### DROUGHT.

Boisé City, Idaho, 20th: rain is much needed; grass is drying up and the cattle interests are suffering in consequence. Springfield, Mo., 23d: the dry weather and brisk winds of the past fourteen days have been injurious to winter wheat.

Key West, Fla.: the rains of the 25th and 26th broke the drought which had prevailed on this island since the middle of December last; the only rain affording relief previously to the above dates was that of March 11th, which was of but slight benefit.

Yankton, Dak.: the rain of the 27th greatly benefited crops which were suffering from drought.

Decatur, Macou Co., Ill., 27th: throughout central Illinois drought has greatly injured the hay, wheat, and oat crops. Reports from Monticello, Piatt Co., state that the wheat crop has suffered to such an extent that much has been plowed up and the ground planted in corn.

Goshen, Elkhart Co., Ind., 27th: wheat and hay in this vicinity have been much injured by the drought.

Cairo, Ill., 27th: farmers from the surrounding country report that crops are suffering for rain.

Grand Haven, Mich., 27th: the prevailing dry weather is causing considerable injury to the spring crops.

University, Miss.: the low temperature and the deficiency in rainfall during the latter part of the month affected the growing crops injuriously throughout the state; light rain fell during the night of the 29-30th.

Fort Bidwell, Cal., 30th: the month has been very dry, the total rainfall being only 0.16 inch; much anxiety is felt by stockmen and farmers.

Lewis Creek, Tulare Co., Cal., 30th: the past month was the driest April for years.

Pekin, Tazewell Co., Ill.: at the end of the month the drought in this section had become very serious, but the rainfall of the 30th brought some relief.

Oswego, Kendall Co., Ill.: the rain, 0.55 inch, which fell

on the 30th was of great benefit to small seed, and to crops in general, which were suffering for rain.

Butlerville, Jennings Co., Ind., 30th: the excessive dryness during the month has retarded the growth of grain, especially the late sown oats; it has also retarded sprouting of seed.

Beverly, Burlington Co., N. J., 30th: rain is much needed in this section.

Augusta, Ga.: the total precipitation for the month, 0.87, inch, is the smallest amount recorded for April since the establishment of the Signal Service station in 1870. The deficiency of precipitation in this vicinity has been favorable to the planting of cotton, but has retarded early vegetation.

#### FOREST AND PRAIRIE FIRES.

Fort Sully, Dak.: prairie fires were burning on the Missouri River opposite this place on the 10th, and from the 12th to 14th they were burning in all directions about this place; extensive fires also occurred west of the station on the 21st.

Cape Henry, Va.: on account of forest fires west of station, this place was enveloped with dense smoke on the 29th and 30th.

Canajoharie, Montgomery Co., N. Y.: an extensive forest fire burned along the line of the New York Central Railroad on the 26th.

Forest and prairie fires were also reported during the month as follows: Las Animas and Pike's Peak, Colo., Fort Reno, Ind. T., and Topeka, Kans., 1st; Fort Sill, Ind. T., 1st to 7th, 14th, 15th; Valentine, Nebr., 4th; Huron, Dak., 7th; Fort Yates, Dak., 8th, 9th, 12th, 20th; Yankton, Dak., 13th; Moorhead, Minn., 13th, 18th to 20th, 24th to 29th; Fort Elliott, Tex., 14th; Poplar River, Mont., 15th, 19th, 24th, 30th; McMinnville, Oregon, and Rapid City, Dak., 20th to 25th; Fort Buford, Dak., 22d, 23d; Clayton, N. J., 25th, 28th; Wellsborough, Pa., 25th to 30th; Humphrey, N. Y., 28th to 30th.

#### HALOS.

Solar halos were reported every day during the month in some part of the country, except on the 21st, when none were

reported; they were least numerous on the 14th, 24th to 27th, and most numerous on the 1st, 5th, 7th, 13th, 17th to 19th, and 31st; they were observed on from ten to sixteen dates in the following states and territories: Cal., Dak., Me., N. Y., Oregon, and Wash.

Only a few lunar halos were reported from the 1st to 15th and on the 28th and 29th, but during the remainder of the month they were generally observed throughout the country, being most frequent on the 17th, 18th, 21st to 23d, and 25th; none were observed on the 5th, 7th, 8th, 27th, and 30th; they were most frequently observed in California and Oregon.

The phases of the moon, Washington mean time, during April, as given in "The American Ephemeris and Nautical Almanac," are as follows: last quarter, 2d, 19h. 33m.; new moon, 10th, 15h. 59.5m.; first quarter, 18th, 18h. 44.2m.; full moon, 25th, 13h. 14m.; apogee, 12th, 5.7h.; perigee, 25th, 15.7h.

#### METEORS.

Webster, Day Co., Dak.: a fine meteor was observed in the western sky at 7.30 p. m. on the 6th; it was apparently as large as Venus, of yellowish color, and left a long trail.

Dudley, Worcester Co., Mass.: a meteor was observed at 12.10 a. m., 7th; it started in the west about 20° from the zenith and moved southward, leaving a train of brilliant sparks.

Meteors were also observed as follows: 1st, Savannah, Ga. 4th, Beverly, N. J. 5th, Pekin, Ill. 6th, Voluntown, Conn., and Columbia, S. C. 7th, New Market, Ala. 8th, Huron, Dak. 9th, Nashua, N. H. 10th, Wauseon, Ohio. 13th, Manhattan, Kans.; Moorhead, Minn. 15th, Orono, Me. 16th, Cedar Keys and Duke, Fla. 18th, Parkston and Webster, Dak.; Cedar Keys, Fla.; Beverly, N. J. 19th, Red Bluff, Cal.; Manatee, Fla.; Kalamazoo, Mich. 22d, Parkston, Dak.; Utica, N. Y. 23d, Red Bluff, Cal. 26th, East Norway, Kans.

27th, Red Bluff, Cal. 28th, Fort Meade, Fla.; Indianapolis, Ind. 29th, Elkin, Ky.; College Hill, Ohio. 30th, Cedar Keys, Fla.

#### MIRAGE.

Fort Assinaboine, Mont.: from 9 a. m. to 12.30 p. m. on the 4th the banks of Milk River, distant twelve miles, and ordinarily not visible, were seen from this station.

San Diego, Cal.: on the 12th a beautiful mirage appeared in the southwest, showing the Coronada Islands very distinctly, the two islands being apparently connected by a large suspension bridge.

Parkston, Hutchinson Co., Dak.: an unusually fine mirage was observed on the 18th before sunrise; in some parts of the horizon objects appeared grotesquely elongated and several times their natural size; the images of cattle, distant several miles, were seen having gigantic proportions; also large lakes, with their shores dotted with trees and houses. The display ended at noon, and shortly afterwards the sky clouded over and rain and snow began to fall.

Toledo, Ohio: on the afternoon of the 27th the ice houses on Gard's Island and the light house on Turtle Island were plainly seen from Maumee Bay; two images of the light house appeared, one being inverted. The phenomenon lasted from 6.30 to 7.30 p. m.

Mirages also occurred as follows: Traverse City, Mich., 8th; Yuma, Ariz., 9th; Webster, Dak., 10th, 11th, 18th to 21st, 23d, 30th; Marquette, Mich., 18th to 20th; Duluth, Minn., 24th.

#### SAND STORMS.

Sand storms were reported as follows: Yuma, Ariz., 3d, 24th, 25th, 30th; Willcox, Ariz., 5th, 25th; Rio Grande City, Tex., 8th; San Carlos, Ariz., 13th; Lava, N. Mex., 16th; Fresno, Cal., 25th.

### VERIFICATIONS.

#### INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for April, 1888, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for all districts east of the Rocky Mountains for April, 1888, were made by 1st Lieutenant Robert Craig, 4th Artillery, U. S. Army, Acting Signal Officer and Assistant, except those for Minnesota and Dakota, which were made at Saint Paul, Minn., by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, U. S. Army, Acting Signal Officer; those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Professor C. F. Marvin.

*Percentages of indications verified, April, 1888.*

States.		States.	
Maine.....	84.33	Kentucky.....	84.27
New Hampshire.....	79.97	Ohio.....	80.63
Vermont.....	80.63	West Virginia.....	79.77
Massachusetts.....	78.80	Indiana.....	82.83
Rhode Island.....	78.00	Illinois.....	80.53
Connecticut.....	79.60	Lower Michigan.....	80.93
Eastern New York.....	80.47	Upper Michigan.....	69.07
Western New York.....	76.17	Wisconsin.....	78.57
Eastern Pennsylvania.....	85.80	Minnesota.....	79.07
Western Pennsylvania.....	76.93	Iowa.....	78.37
New Jersey.....	81.77	Kansas.....	81.10
Delaware.....	83.63	Nebraska.....	79.27
Maryland.....	82.20	Missouri.....	77.60
District of Columbia.....	83.33	Colorado.....	78.57
Virginia.....	79.53	Eastern and Southwestern Dakota*.....	79.47
North Carolina.....	78.53	Southern California*.....	79.87
South Carolina.....	81.87	Northern California*.....	80.93
Georgia.....	80.70	Oregon*.....	74.95
Eastern Florida.....	82.07	Washington Territory*.....	70.65
Western Florida.....	82.33	By elements:	
Alabama.....	83.53	Weather.....	83.43
Mississippi.....	81.00	Wind.....	77.36
Louisiana.....	80.80	Temperature.....	77.38
Texas.....	80.83		
Arkansas.....	77.60	General average.....	80.41
Tennessee.....	83.50		

\* In determining the general average percentage for the different elements, Minnesota, Dakota, and the Pacific coast states have not been included.

#### CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during April, 1888, it was practicable to determine the justification or failure of thirty-two; justified, sixteen, or 50.00 per cent. Of the above, twenty were ordered for cautionary signals; number justified, thirteen, or 65.00 per cent. Twelve storm signals were ordered; justified, three, or 25.00 per cent. Total number of direction signals ordered, forty-seven; justified, forty-four, or 93.62 per cent. Number of signals ordered for easterly winds, twenty-four; justified, twenty-one, or 87.50 per cent. Number of signals ordered for westerly winds, twenty-three; all, or 100 per cent., of which were justified. Number of storms without signals, twenty-five. Number of signals ordered late, *i. e.*, after the justifying velocity had begun, one, or 3.12 per cent.

#### COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered from Office Chief Signal Officer, sixty-two; justified, forty-one, or 66.13 per cent. Twenty-nine cold-wave signals were ordered during the month by the Signal Service Officer at Saint Paul, Minn., of which, fourteen, or 48.28 per cent., were justified.

#### LOCAL VERIFICATIONS.

The following extracts from the published reports of the state weather services for April, 1888, show the percentages of verification of weather and temperature signals for the various states:

*Michigan.*—Weather and temperature signals are now displayed in one hundred and forty towns in the state, and upon the baggage-cars of twenty-six trains of eight of the principal railroads of the state.

The indications and cold-wave warnings are issued by the Chief Signal Officer and distributed to the different stations through the central office. The indications are issued at 1 a. m., daily, from the Chief Signal Office, Washington, and are for the twenty-four hours from 7 a. m. to 7 a. m.

The percentage of verification of these indications for April is as follows (the verification is taken from reports of displaymen furnished this office monthly): temperature, 83.8 per cent; weather, 77.8 per cent.; temperature and weather, 80.8 per cent.